EUROPEAN POULTRY PRODUCTION WITHOUT ANTIBIOTIC GROWTH PROMOTERS – ONE YEAR ON

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Summary

The use of growth-promoting antibiotics is being placed under increased pressure due to consumer concerns in both Europe and Asia Pacific about associated resistance against pathogenic bacteria in humans. The majority of the broiler production in the UK is now without antibiotic growth promoters and much of the past twelve months has been spent evaluating the effects of their removal and the various feed and management factors that influence performance and disease, particularly necrotic enteritis (NE).

I. INTRODUCTION

Just over one year ago a significant proportion of the European broiler industry removed in-feed antibiotic growth promoters (AGPs) following pressure from the major supermarkets due to concerns regarding possible antibiotic resistance in humans (Ratcliff, 2000). At the same time, tight monitoring procedures were implemented to ensure that the practice of prophylactic treatment was stopped and therapeutic antibiotic treatment did not increase, as was the case in the proceeding twelve months following the removal of AGPs in Sweden (Best, 1996).

Following the European Union (EU) ban on avoparcin, the most commonly used growth promoters in Europe were zinc bacitracin and virginiamycin. These growth promoters were selected not just for their improved production performance but because they also provided effective protection against NE, even in the absence of an ionophore coccidiostat. Experience from Denmark and Sweden has confirmed that one of the key problems for countries reliant on wheat-based formulations is the control of NE once antibiotic growth promoters have been removed (Inborn, 2000).

In 1999 the extended growth promoter ban within the EU left the broiler industry with only avilamycin or bambermycin for use as in-feed AGPs. Neither was considered to be as effective as zinc bacitracin or virginiamycin in the control of NE and inevitably NE breakdowns were occurring even before the move to remove all AGPs came at the end of 1999.

As a consequence, current European broiler programmes without AGPs have tended to concentrate on limiting the increase in health problems, especially NE, associated with the removal of growth promoters.

II. NECROTIC ENTERITIS

Necrotic enteritis is caused by the intestinal proliferation and toxin production of Clostridium perfringens (CP) types A and C (Ficken et al., 1997). This bacterial species is so prolific and environmentally resistant that it represents one of the major threats to intensive poultry production. Intestinal proliferation of CP has been associated with acute clinical disease and increased mortality (Kaldhusdal et al., 1992) whilst the sub-clinical disease is associated with impaired performance and liver lesions (cholangiohepatitis) resulting in

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increased carcass condemnation at slaughter (Randall et al., 1996).

The damage caused by CP depends largely on those factors that favour colonisation of the gut. It is thought that the slowing down of the gut flow during the process of digestion allows the *clostridium* bacteria to proliferate. Factors that increase the viscosity of the gut contents further encourage proliferation. Outside of the bird in the litter and the feed, *clostridium* bacteria will form spores that are highly resistant to desiccation, chemicals and heat. These spores present the risk of infection and re-infection.

III. STRATEGIES TO CONTROL NECROTIC ENTERITIS IN THE ABSENCE OF ANTIBIOTIC GROWTH PROMOTERS

Strategies to control NE in the absence of AGPs, without resorting to prophylactic or therapeutic treatment, have centred upon dietary and management practice (Table 1). The influence of feed and feed characteristics is evident throughout this list and highlights the importance of feed production in the control strategy.

Table 1. Factors associated with the occurrence of necrotic enteritis.

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(a) Coccidiostat programme

Coccidial stress has been shown to sensitise the broiler chicken to NE (Al-Sheikhly et al., 1980). Control of coccidiosis is, therefore, an essential element in the strategy for the control of NE. The inclusion of the polyether ionophore group of coccidiostats in feed is known to have a beneficial effect in the control of NE (Williams et al., 1999). Experience with commercial coccidial vaccines for broilers may lead to an increase in the incidence of NE as may the use of chemical in-feed coccidiostats. The inclusion of an ionophore coccidiostat would be the recommended option in the absence of an AGP.

(b) Processed feed characteristics

Normal gut motility is regulated by the gizzard (Duke, 1994). In birds, gut refluxes (reverse peristalsis) are normal and are an adaptation to compensate for a short intestine. The gut refluxes serve to re-expose intestinal ingesta to gastric secretions, to vigorously mix digesta with enzymes, to enhance nutrient absorption over a short segment of the gut and to discourage pathogenic proliferation that may cause disease or compete for nutrients (Fercket, 1995). It is observed that highly processed feeds can lead to atrophy and malfunction of the gizzard which then acts more like a transit organ rather than a grinding organ (Cumming, 1994). Normal gastric reflex does not occur when birds consume highly processed feed and as a consequence more undigested proteins end up in the hindgut where they are subject to microbial fermentation. One of the consequences is the potential for finely ground material to trigger the proliferation of *clostridia* and hence NE. As a consequence particle size is now seen as an important precursor for NE and efforts have been made to maximise the particle
size without compromising pellet quality. Grinding raw materials over a 4mm sieve has been found to be beneficial.

(c) Raw material characteristics

The viscosity characteristics of wheat are well documented and, even in the presence of an enzyme, wheat is known to be associated with a higher incidence of NE compared with maize (Kalduhsdal, 1996). As a result, in some countries, such as Denmark, they have replaced up to 30% of the wheat in the starter and grower ration with maize although in many poultry producing areas such a strategy is not practical. However, recent DNA profile methods of analysing microbial communities in the gastrointestinal tract have shown significant shifts in the microbial population which may favour the development of NE when changing from maize to wheat or rye during the broiler cycle (Apajalahti et al., 2000).

(d) Whole wheat addition

Many broiler companies in Europe have been diluting the broiler feed by adding up to 30% whole wheat over the top. The economic benefits of this practice are well documented (Peterson, 1997). However, the feeding of whole wheat to turkeys and broilers is now considered beneficial, not only because of the commercial returns, but also because of the stimulation to the function of the gizzard and the resulting benefits on gut motility. This, in turn, is felt to be beneficial in helping to inhibit the proliferation of clostridia.

(e) Protein digestibility

Reports on the influence of protein sources on the frequency of NE are conflicting. There has been a suggestion that protein ingredients of animal origin (meat meal and fish meal) predispose to NE (Teglof et al., 1992) although more recent studies have not confirmed this. The issue is one of nutrient density and protein quality rather than protein source. High levels of low quality protein sources are poorly digested in the foregut and, thus, pass to the hind gut where they are degraded by proteolytic bacteria such as clostridia resulting in the production of alpha toxin. Consequently protein levels should be kept to a minimum with the emphasis on protein quality and constraining to available amino acid levels rather than total protein.

(f) Feed toxins

Spoiled meat and poor quality fish by-products are a source of biogenic amines, histamine and tyramine, which can cause or aggravate an enteritis problem if they exceed 100 mg/kg in the finished feed. The purchase of high quality fish and animal by-products is, therefore, recommended. Personal experience with a feed company in the UK traced a NE problem last year back to the biogenic amine levels in the source of fishmeal. Other toxin problems may result from mycotoxins or oxidised fats. Again, the emphasis must be on quality control.

Kaldhustal (2000) has speculated that the possibility of contamination of poultry feed with CP should not be excluded. Heat treatment and the application of anti-microbial acids would not be sufficient to destroy the CP spores. By effectively reducing other pathogens in the feed such treatment may actually encourage the proliferation of CP within the bird.
(g) Gut conditioners

It is well documented that addition of carbohydrase enzymes to barley-, rye- or wheat-based diets can reduce or eliminate the anti-nutritive properties of viscous polysaccharides in broiler chicks. Lipase, phytase and protease preparations are also now widely used in poultry rations as a means of improving digestion and nutrient absorption although their effect on NE occurrence is not documented.

The accepted use of betaine as a methyl donor in poultry formulations can also provide beneficial protection to the structure of the epithelial cells in the gut, improving nutrient absorption and fluid retention, particularly under stress conditions (Ferket, 1995).

(h) Nutrition

While a tremendous amount of research is devoted to amino acid and energy requirements of poultry the importance of trace minerals is frequently ignored. Dietary inclusions of many trace minerals have remained constant despite the significant improvement in food conversion and the incredibly rapid growth rate of modern broiler breeds. Greater understanding of the co-factor relationship between many trace minerals, vitamins and key enzymes has been accompanied by a greater awareness of the significant difference in bioavailability between organic and inorganic forms of mineral supplementation and the effect this can have on performance, the immune defence and antioxidant protection systems (Surai et al., 2000).

(i) Alternative Additives

A summary of the main categories of alternative products available in Europe has already been documented (Ratcliff, 2000). Currently the three most widely used alternatives in the UK are organic acids, essential oils and mannooligosaccharides (MOS), either individually or in combination.

The first alternative programme with which the author became involved in the UK was the evaluation of MOS compared with avilamycin in broilers under commercial conditions, both in combination with monensin. The results, repeated over twelve months, showed comparative performance between the two treatments. It was observed on a number of farms however that both treatments showed an increase in the incidence of cholangiohepatitis resulting in an increased level of condemnations at the processing plant.

Since experience with organic acids had suggested a potential benefit in terms of NE control it was decided to apply an organic acid preparation in the drinking water for the first five days in combination with MOS in the feed. Since progressing to this programme little or no incidence of NE or cholangiohepatitis has been observed. The addition of organic acids to feed is widely practiced as a means of controlling microbial growth but nutraceutical benefits have also been discussed (Adams, 2000). Any pH effect in the bird is likely to be very limited and restricted to the crop and the proventriculus. Beyond the gizzard the free organic acids are rapidly metabolised and, therefore, there is unlikely to be any effect on the pH in the hind gut unless the acid in the feed is in some way protected through to the small intestine and caecum (Hyden, 2000). The bacteriostatic action of the acids in the intestine will depend not only on their ability to reduce the pH value but more importantly their ability to penetrate and destroy the bacterial cell (Cerchiari et al., 2000). A range of products are now available that exploit this technology in an attempt to influence the growth of pathogenic bacteria in the hind gut.
The comparison of alternative products with avilamycin became academic towards the end of 1999 because the UK moved rapidly towards the complete removal of AGPs such that currently the majority of broilers reared in the UK are now AGP free. A number of companies decided that initially they would try to run without any alternative product. Companies that were using a chemical coccidiostat soon ran into problems with NE and were having to resort to treatment with antibiotics. Where an ionophore coccidiostat was used, in many cases the first two or three crops showed little setback in performance in terms of liveweight, feed conversion and mortality. The parameter that did deteriorate was liveweight uniformity. After three successive crops the performance did, however, start to suffer both in terms of feed conversion (up to four points), liveweight and mortality resulting in an increase in therapeutic treatment. With pressure being applied by the supermarkets to reduce therapeutic treatments the option of no alternative was not considered a long-term viable alternative.

The verdict on essential oils and herb extracts is still not conclusive. Personal observations indicate a lack of consistency over a sustained period of time such that in many cases it is difficult to achieve an economic benefit against negative controls. A problem also arises from the lack of active ingredient studies and dose response data.

Finally, competitive exclusion products may provide effective means of controlling NE in the absence of AGPs. Further evaluation is, however, required.

(j) Management practice

It is clear from published data that there is an important association between dietary ingredients and nutrition and NE in poultry, albeit that some of these data are conflicting due to the complex multifactorial nature of the disease. Diet is an important predictor of disease risk but many other factors are involved. The brooding stage (0-10 days) remains of key importance. With increasing growth rate the bird spends proportionately more time in this stage than in the past and with increasing genetic potential for growth, inputs during the brooding process become more important (Ross Breeders Technical Bulletin, 1998). Correct temperature, humidity and feed presentation are essential during this phase of development.

Other factors that can influence NE include, drinkers, stocking density, litter material, clean out and turn-around time. Immunity and concurrent diseases (particularly coccidiosis) will also be a major influence.

IV. CONCLUSIONS

The removal of antibiotic growth promoters from broiler and turkey feeds in Europe has led to a complete re-assessment of management practice and, in particular, the influence of feed and its components on necrotic enteritis. The use of an ionophore coccidiostat is the preferred option in conjunction with a careful evaluation of individual feed ingredients and nutrient levels and their physical presentation within the pelleted feed. Gut conditioners, particularly enzymes, are considered an essential and effective tool for counteracting the anti-nutrient factors in feed ingredients that may predispose birds to NE. The use of no alternative would not appear to be a viable long-term option for broilers due to a deterioration in performance and the corresponding reliance on therapeutic medication. A number of alternative treatments have been shown to be effective compared with AGPs either individually or in combination, e.g. MOS and organic acid. Further work is required to evaluate the efficacy of competitive exclusion products against NE. Finally, any strategy involving feed can only be considered in conjunction with other management factors such as environment, hygiene and disease control.
REFERENCES


